

What is claimed is:

1. A network apparatus that interconnects two or more (= N) basic elements each having the capability to function as one computer, comprising:

N switch device groups each having N switch
5 devices, each of said N switch device groups being electrically configured such that one of said N switch devices is connected to one of said basic elements without duplicity, i.e., without selecting the same basic
10 element twice and first to Nth switch devices are connected in series in the order that a first switch device is connected directly to a basic element, a second switch device is connected to said first switch device, a third switch device is connected to said second switch
15 Nth switch device being connected to a (N-1)th switch device, and

N loop lines, each being configured by connecting one switch device in each of N switch device groups in a loop without duplication, i.e., without
20 selecting the same device twice.

2. A network apparatus according to claim 1 wherein, if a number n (where $1 \leq n \leq N$) denotes an nth switch device, said loop line connects a switch device of each switch device group in a loop such that the switch

5 device numbers increase one by one with progression around the loop line in either a clockwise or counter-clockwise direction and such that the switch device of switch device number N is connected to the switch device of switch device number 1.

3. A network apparatus according to claim 2 wherein said one of said basic elements and said first switch device, i.e., switch device 1 are bidirectionally connected for input and output of data.

4. A network apparatus according to claim 3 wherein each of the switch devices that constitute said switch device group is unidirectionally connected for one-way transfer of data toward said first switch device.

5. A network apparatus according to claim 4 wherein connections between each of the switch devices that make up said loop lines are bidirectional connections for data transfer.

6. A network apparatus according to claim 5 wherein each of the switch devices that constitute each switch device group comprises:

a first port exclusively for receiving data
5 attached with destination information received from an

adjacent switch device in the same switch device group;

a second port exclusively for receiving data attached with destination information received from a basic element only when said switch device is directly connected to that basic element;

a third port and a fifth port for both input and output connected to said loop line;

a first and a second decoder for judging whether data attached with destination information received from said third port or fifth port, respectively, are communication addressed to a basic element connected to the switch device group concerned or communication addressed to a basic element connected to another switch device group;

a switch unit for, in a case in which it is judged by said first or second decoders that data attached with destination information are addressed to said basic element connected to the switch device group concerned, selecting either that data addressed to the basic element concerned or data attached with destination information that have been received from said first port;

first and second repeaters for, in a case in which it is judged by said first and second decoders, respectively, that data attached with destination information are not addressed to said basic element connected to the switch device group concerned, repeating

that data attached with destination information;

first and second selectors for selecting one of: data attached with destination information that have
35 been received from said first and second repeaters and data attached with destination information that are received from said second port, to send the selected data to said fifth port or third port, respectively; and

a fourth port exclusively for delivering data
40 attached with destination information selected by said switch unit to a switch device adjacent in the direction of the basic element in the switch device group concerned or to the basic element.

7. A network apparatus according to claim 6 wherein first and second selectors of the switch device directly connected to said basic element make a fixed selection of only data attached with destination
5 information that are received from said second port.

8. A network apparatus according to claim 6 wherein first and second selectors of the switch device connected to an adjacent switch device in the same switch device group by way of said fourth port make a fixed
5 selection of only data attached with destination information that have been sent from said first and second repeaters, respectively.

9. A network apparatus that interconnects two or more pairs (= N pairs) of basic elements, each basic element having the capability to function as one computer, comprising:

5 N switch device groups each having N switch devices, each of said N switch device groups being electrically configured such that: one of said N switch devices is connected to one pair of said basic elements without duplicity, i.e., without selecting the same basic
10 element twice; and first to Nth switch devices are connected in series in the order that a first switch device is connected directly to a basic element, a second switch device is connected to said first switch device, a third switch device is connected to said second switch
15 device and so on up to a final Nth switch device, said Nth switch device being connected to a (N-1)th switch device, and

N loop transmission paths, each being configured by connecting one switch device in each of N
20 switch device groups in a loop without duplication, i.e., without selecting the same device twice.

10. A network apparatus according to claim 9 wherein, if a number n (where $1 \leq n \leq N$) denotes an nth switch device, said loop transmission path connects a

switch device of each switch device group in a loop such
5 that the switch device numbers increase one by one with
progression around the loop transmission path in either a
clockwise or counter-clockwise direction and such that
the switch device of switch device number N is connected
to the switch device of switch device number 1; said one
10 pair of said basic elements and said first switch device,
i.e., switch device 1 are bidirectionally connected for
input and output of data; and each of the switch devices
that constitute said switch device group is
unidirectionally connected for one-way transfer of data
15 toward said first switch device.

11. A network apparatus according to claim 10
wherein each of said N loop transmission paths is
composed of two loop lines, whereby the two basic
elements connected to the same switch device group
5 communicate with basic elements connected to other switch
device groups through different loop lines of the same
loop transmission path.

12. A network apparatus according to claim 11
wherein each switch device comprises a first and second
basic switch circuit, and each of the basic switch
circuits comprises:
5 a first port exclusively for receiving data

attached with destination information that are sent from
an adjacent switch device in the same switch device
group;

10 a second port exclusively for receiving data
attached with destination information that are sent from
a first or a second basic element of said pair of basic
elements only if that switch device is directly connected
to said pair of basic elements;

15 a third port and a fifth port that are
connected to said loop transmission path;

20 a first decoder for judging whether data
attached with destination information that have been
received from said third port are communication addressed
to a basic element that is connected to the switch device
group concerned or communication addressed to a basic
element that is connected to another switch device group;

a switch unit;

25 a fourth port for supplying the output of said
switch unit to a basic element that is connected to the
switch device group concerned; and

30 a repeater for, in a case in which it is
judged by said first decoder that data attached with
destination information are communication addressed to a
basic element that is connected to said other switch
device group, repeating that data attached with
destination information;

said first and second basic switch circuits each further including a selector and a second decoder; wherein:

35 the second decoder of the first basic switch circuit receives, by way of the second port, data attached with destination information from the first basic element that is connected to the second port of the first basic switch circuit and judges whether the data
40 attached with destination information are communication addressed to the second basic element or communication addressed to the basic element that is connected to another switch device group by way of a loop line;

 the second decoder of the second basic switch
45 circuit receives, by way of the second port, data attached with destination information from the second basic element that is connected to the second port of the second basic switch circuit and judges whether the data attached with destination information is communication
50 addressed to the first basic element or communication addressed to the basic element that is connected another switch device group by way of a loop line;

 the switch unit of the first basic switch circuit receives:

55 data attached with destination information that have been received from the first port of the first basic switch circuit; data attached with destination

information that have been received from the third port
of the first basic switch circuit when the first decoder
60 of the first basic switch circuit judges that these data
attached with destination information are addressed to
the first basic element; and data attached with
destination information that have been received from the
second port of the second basic switch circuit when the
65 second decoder of the second basic switch circuit judges
that these data attached with destination information are
communication addressed to the first basic element; and
selects any of these data attached with destination
information, and supplies the selected data to the fourth
70 port of the first basic switch circuit;

the switch unit of the second basic switch
circuit receives:

data attached with destination information
that have been received from the first port of the second
75 basic switch circuit; data attached with destination
information that have been received from the third port
of the second basic switch circuit when the first decoder
of the second basic switch circuit judges that these data
attached with destination information are addressed to
80 second basic element; and data attached with destination
information that have been received from the second port
of the first basic switch circuit when the second decoder
of the first basic switch circuit judges that these data

attached with destination information are communication
85 addressed to the second basic element; and selects any of
these data attached with destination information, and
supplies the selected data to the fourth port of the
second basic switch circuit;

the selector of the first basic switch circuit
90 selects one of:

data attached with destination information
that have been received from the second port of the first
basic switch circuit when the second decoder of the first
basic switch circuit judges that these data attached with
95 destination information are communication addressed to
the basic element connected to another switch device
group; and output of the repeater of the first basic
switch circuit; and supplies the selected data to the
fifth port of the first basic switch circuit; and

100 the selector of the second basic switch
circuit selects one of:

data attached with destination information
that have been received from the second port of the
second basic switch circuit when the second decoder of
105 the second basic switch circuit judges that these data
attached with destination information are communication
addressed to the basic element connected to another
switch device group; and output of the repeater of the
second basic switch circuit;

110 and supplies the selected data to the fifth
port of the second basic switch circuit.

13. A network apparatus according to claim 10
wherein each loop transmission path of said N loop
transmission paths is composed of one loop line, and two
basic elements that are connected to the same switch
5 device group communicate with a basic element connected
to another switch device group through the same loop line.

14. A network apparatus according to claim 13
wherein each switch device comprises:

first port 1-1 for the first basic element and
first port 1-2 for the second basic element, both ports
5 exclusively for receiving data attached with destination
information received from an adjacent switch device in
the switch device group concerned;

second ports 2-1 and 2-2 exclusively for
receiving data attached with destination information that
10 are sent from the first or second basic element,
respectively, only when that switch device is connected
directly to the basic elements;

a third port and a fifth port connected to an
adjacent switch device by way of a loop line;

15 a first decoder for judging whether data
attached with destination information that have been

received from said third port are communication addressed to the first basic element, communication addressed to the second basic element, or communication addressed to a basic element that is connected to another switch device group;

20 a repeater for repeating data attached with destination information when the first decoder has judged that the data attached with destination information are communication addressed to a basic element connected to another switch device group;

25 a second decoder for judging whether data attached with destination information that have been received from second port 2-1 are communication addressed to the second basic element or communication addressed to a basic element that is connected to another switch device group;

30 a third decoder for judging whether data attached with destination information that have been received from second port 2-2 are communication addressed to the first basic element or communication addressed to a basic element that is connected to another switch device group;

40 a first switch for selecting one of data attached with destination information that have been judged by the second decoder to be communication addressed to a basic element that is connected to another

switch device group and data attached with destination information that have been judged by the third decoder to

45 be communication addressed to a basic element that is connected to another switch device group;

a selector for selecting one of: data attached with destination information that have been selected by said first switch and data attached with destination
50 information that have been supplied from said repeater and delivering the selected data by way of the fifth port;

a second switch for selecting one of: data attached with destination information that have been
55 received from first port 1-1; data attached with destination information that have been determined by the first decoder to be communication addressed to the first basic element; and data attached with destination information that have been judged by the second decoder
60 4-2 to be communication addressed to the first basic element;

a third switch for selecting one of: data attached with destination information that have been received from first port 1-2; data attached with
65 destination information that have been judged by the first decoder to be communication addressed to the second basic element; and data attached with destination information that have been judged by the second decoder

to be communication addressed to the second basic

70 element;

fourth port 4-1 for delivering data attached with destination information that have been selected by said second switch to another switch device in the same switch device group or to the first basic element; and

75 fourth port 4-2 for delivering data attached with destination information that have been selected by said third switch to another switch device in the same switch device group or to the second basic element.